

From jimr@maia.usno.navy.mil Tue Mar 28 16:43:37 EST 2000
 Received: (from jimr@localhost)
 by maia.usno.navy.mil (8.9.3 (PHNE_18979)/8.9.3) id QAA22734
 for gpst@maia; Tue, 28 Mar 2000 16:40:57 -0500 (EST)
 From: Jim Ray (USNO 202-762-1444)
 Message-Id: <200003282140.QAA22734@maia.usno.navy.mil>
 Subject: [GPST] NPL JPS receiver test
 To: gpst@maia.usno.navy.mil
 Date: Tue, 28 Mar 2000 16:40:57 EST
 X-Mailer: Elm [revision: 212.5]
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Forwarded message (for those who do not get IGS Mail):

From: Jon Clarke
 To: IGS_IGSMail
 Subject: [IGSMail-2768]: NPL JPS receiver test
 Date: Tue, 28 Mar 2000 16:03:57 +0100

 IGS Electronic Mail 28 Mar 09:56:30 PST 2000 Message Number 2768

Author: Jon Clarke
 Subject: NPL JPS receiver test

Dear Colleagues,

recently, with the kind assistance of Javad Positioning Systems, NPL borrowed and tested a JPS EuroCard receiver to attempt to establish its usefulness for carrier phase time transfers. I have posted the raw data and results on an anonymous ftp site (see message below).

The JPS website is <http://www.javad.com/> and gives a number of technical details, including a downloadable version of the GPS receiver interface language document, which explains the contents of the JPS proprietary format files.

Please feel free to use this data - I hope it is useful to some of you. We would appreciate any feedback on the results, or reports on any problems encountered.

Note that Rinex from our main receiver, NPLB, and CGGTTS common view data for our R100 GPS/Glonass receiver are also available via ftp according to instructions listed below the Javad message.

Regards,
 Jon

JPSTest ftp

server: ftp.npl.co.uk
 user: anonymous
 password: [your e-mail address]
 directory: pub\time\jpstest\

Dear Colleagues,

this ftp directory holds the data and analysis resulting from a test of a Javad Positioning Systems EuroCard receiver at NPL from 1 March 2000 to 21 March 2000. Please feel free to use this data.

The test was an attempt to see whether the JPS receivers are suitable for use in carrier phase time transfers, and thus to answer the following points:

- 1) considering that the receiver does not take a synchronising 1pps, could the arbitrary offset to the reference clock be measured?
- 2) as the internal clock is disciplined to a reference frequency, could this disciplining be measured?
- 3) is there a significantly poor temperature coefficient?
- 4) what are the effects of power cycles?

I feel the tests have answered these questions reasonably to my satisfaction.

If you have any questions or comments please contact me (details below).

Comments:

- 1) to calculate the offset between the UTC(NPL) 1pps and the receiver internal clock it is necessary to calculate the following:

$$\text{UTC(NPL)} - \text{JPS 3D UTC(NPL)} - \text{B5 offset} + \text{CT} - \text{T0} + \text{ZA}$$
 where:
 B5 offset 3D offset due to local reconstruction of 1pps in Building 5
 (time transfer lab), as UTC(NPL) is in building 2,

$$3\text{D } 8450 \pm 30 \text{ ns (exact measurement to be done soon),}$$
 stable to <1ns.
 CT 3D counter-timer measurement (be careful of signs, as I triggered from the JPS, not from my reference),
 T0 3D JPS reported offset of (internal clock - GPS time),
 ZA 3D JPS reported GPS time mod 25 ns, to overcome 25ns hardware quantisation of 1pps output (which is GPS time).

Derivation:

Denoting -
 counter-timer readings CT,
 reference time T(ref),
 Javad internal clock time T(Javad),
 Javad 1pps output time T(out),
 GPS time T(GPS),
 the quantisation operator qua,
 the modulus operator mod,

$$\text{T(out)} \text{ 3D } \text{T(GPS)} \text{ qua } 25\text{ns} \text{ 3D } \text{T(GPS)} + \text{ZA}$$

$$\text{T0 3D } \text{T(Javad)} - \text{T(GPS)} \text{ [this appears to contradict]}$$

$$\text{[the JPS GRIL document!]}$$

$$\text{ZA 3D } \text{T(GPS)} \text{ mod } 25\text{ns} \text{ 3D } \text{T(out)} - \text{T(GPS)}$$

CT 3D T(ref) - T(out)
 3D T(ref) - [T(GPS) qua 25ns]

CT - T0 + ZA 3D T(ref) - T(out) - T0 + ZA
 3D T(ref) - T(out) - T(Javad) + T(GPS) + T(out) - T(GPS)
 3D T(ref) - T(Javad)
 3D sync. constant + Javad clock drift

- 3) JPS proprietary format files: these are ASCII text characters followed by binary message contents, and must be interpreted in order to obtain the ~/RT time-stamp, and T0 and ZA messages.
- 2) counter-timer measurements: there was a problem with our logging (due to syncing problems between the time scale generator and the PC) so some points are missing (there should be one every second). I am suspicious of the time-stamping on points where there are problems - it may be that the stamp shows when the attempt to log a point started, rather than the 1pps which it actually managed to measure. There are enough valid points that useful conclusions may be drawn.

Regards,
 Jon

012345678901234567890123456789012345678901234567890123456789

Equipment

JPS Eurocard receiver,
 LegAnt antenna,
 SR620 ps-resolution counter-timer,
 PC to log receiver and counter-timer,
 TST/Trak 6460-11 Time scale generator as timing reference for syncing
 PC,
 reference 1pps, derived from UTC(NPL),
 reference 5MHz, derived from UTC(NPL),

Arrangement

See file Arrangment.gif for how equipment was connected. Also see existing equipment arrangement in TTSetup7.gif.

Data

- 1) logging the JPS 1pps output (GPS time qunatised to 25ns) on a ps-resolution counter-timer against an NPL reference 1pps.
 This allows a measurement of
 - i) how the receiver internal clock is tracking the external 5MHz reference.
 - ii) the arbitrary offset (which changes on each power cycle) between the internal receiver clock and the reference 1pps.

- 2) logging the JPS proprietary format files to

- i) form Rinex for submission to the University of Berne for differential carrier phase analysis,
- ii) obtain the T0 and ZA values that allow the lpps output to be corrected to GPS time, and then internal receiver clock time.

Sub-directory	Contents
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Rinex	Z-compressed compact Rinex format data.
JPS	JPS proprietary format binary files. These files are large, and so I have only placed a selection.
CT	Counter-timer measurement files as a zip archive. These are entirely raw, unprocessed files.
Analysis	Excel spreadsheets containing my analysis:
how	51609_StepByStep.xls shows all relevant data sets, and
calculated.	the residual NPL ref - JPS internal clock may be
calculated	51614_LocalVsBerne.xls compares the local residuals (with
results	a 5 minute rolling average to reduce noise), as
receiver	above, against the 5 minute epoch Bernese analysis
cycles	from Berne for the JPS receiver vs. our reference
of	NPLB (Ashtech Z12T), which is locked to UTC(NPL).
	51619_TempAndPower.xls shows the effects of two power
	on the arbitrary offset, and the effects of two cycles
	heating.
	51622_WholeDay.xls shows a whole day's residuals.

Author: Jon Clarke, 2000-03-28.

INSTRUCTIONS FOR ACCESSING CTM FTP ARCHIVES

Directions on using our Ashtech data FTP archive

This site holds our Ashtech Z12T geodetic GPS receiver observation files, in UNIX-compressed compact RINEX format.

Connect to server: ftp.npl.co.uk
 Username: anonymous
 Password: [your e-mail address]
 Move to our archive directory: cd pub/gpsphase

Then there are various useful commands, such as:
 List commands: help
 List contents: dir

obtain file: get [filename - this is case sensitive]

To leave: quit

Other data available via anonymous ftp

3S Nav R100-40T common view time transfer data: pub/time/glonass

GPS common view time transfer data (this is used for our routine
link with BIPM to contribute UTC(NPL) to UTC(BIPM)): pub/time/gps

Please contact me if you have any difficulties.

Regards,
Jon Clarke, 1998-02-24.

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tel: +44 (0) 20 8943 6548                   National Physical Laboratory,
fax: +44 (0) 20 8943 6529                   Queens Road, Teddington, TW11 0LW, U.K.
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